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(71) Applicant: WILLIAMS INTERNATIONAL CO., L.L.C. [US/US]; 2280 West Maple Road, Walled Lake, MI 48390 (US).

(72) Inventor: WILLIAMS, Samuels, B.; 1625 Lochridge, Bloomfield Hills, MI 48302 (US).

(74) Agents: LYON, Lyman, R. et al.; Suite 207, 3883 Telegraph Road, Bloomfield Hills, MI 48302–1476 (US).

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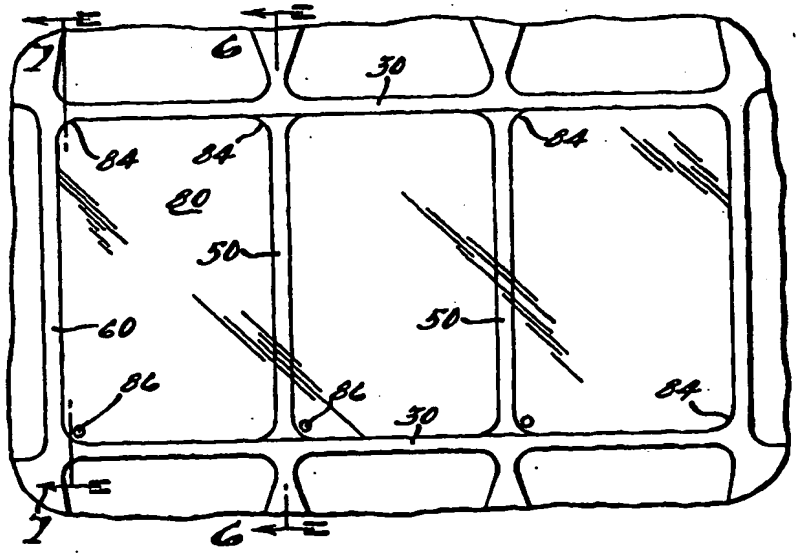

(57) Abstract

The instant invention generally relates to a double–paned window (10) for an aircraft (20) providing greater passenger visibility and overall area than known–in–the art window construction. Specifically, the invention provides for a pair of generally parallel longitudinally extending trusses (30) intersected by a plurality of spaced laterally extending interior (58) and end posts (60) to provide a strong, lightweight structure for an aircraft window. The structural members can be comprised of composite material or known–in–the art aircraft alloy materials that are integral with and taper into the fuselage skin. A plurality of rabbets (34, 36) disposed around the perimeter of both the horizontal trusses (30) and vertical posts (50, 60) engage both a continuous interior window (80) and a plurality of exterior windows (70) to prohibit window blowout.

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AIRCRAFT WINDOW

BACKGROUND OF THE INVENTION

The instant invention relates generally to aircraft windows and more particularly to an aircraft window comprising posts and trusses that are integral with a composite fuselage. The window frame posts and trusses are of minimal width to maximize passenger visibility.

Conventional aircraft window construction, particularly in small business aircraft applications, generally comprises a plurality of small elliptical or circular window panes, often constructed of plexiglass or polycarbonate material, arranged adjacent the passenger seating areas and recessed within the skin of the aircraft fuselage. Known-in-the-art windows are generally of minimal size due to the difficulty of maintaining a pressure seal around each window, and the subsequent loss of cabin pressurization resulting from an inoperative window seal. Additionally, prior art windows have been designed to be relatively small in order to maintain sufficient strength and stiffness throughout the fuselage structure to bear the considerable forces acting on the airframe in flight.

As a result, prior art jet aircraft windows provide for only limited passenger visibility outside the aircraft. An aircraft passenger cabin having a relatively small cross sectional area in conjunction with small passenger windows contributes to and exacerbates the phenomenon of claustrophobia experienced by some aircraft passengers. The relatively wide structural members comprising the fuselage sections between the windows prohibit increasing the size of the windows appreciably and further contribute to the perception of being enclosed in a small space. These wide posts are required in most airframes to dissipate forces such as hoop tension resulting from cabin pressurization and the shear forces associated with bending stress acting on the fuselage.

SUMMARY OF THE INVENTION

The instant invention utilizes top and bottom longitudinal trusses in conjunction with a plurality of lateral posts disposed therebetween to provide a strong, lightweight structure integrated within a composite or alloy aircraft fuselage for aircraft passenger windows. Both the longitudinal trusses and the lateral posts are comprised of lightweight, known-in-the art alloy or composite material having a substantially greater cross-section than the fuselage skin of the aircraft.

The longitudinal trusses are integral to the fuselage skin along one edge thereof and have a reinforcement portion comprised of composite or alloy material tapering into the fuselage skin at the intersections of the longitudinal trusses and lateral posts. The tapered reinforcement sections are utilized to distribute the loading forces acting upon the window and fuselage evenly throughout the intersection of the fuselage and the longitudinal trusses. The longitudinal trusses have a first edge portion having interior and exterior rabbets thereon for engaging an interior windowpane and a plurality of exterior windowpanes respectively.

A plurality of lateral posts are disposed between and intersect the horizontal trusses. At each point of intersection between the posts and the trusses, the relatively rectangular post cross-section widens longitudinally into the longitudinal first edge portion, forming an arcuate intersection thereof. The aforementioned tapered sections distribute the forces due to hoop tension acting on the lateral posts to the longitudinal trusses and thereafter, to the fuselage skin. An additional second tapered composite or alloy reinforcement section disposed between the longitudinal trusses and the fuselage skin at the points of intersection of the lateral posts and the longitudinal trusses is further provided to strengthen the window structure. The second reinforcement section widens longitudinally and tapers laterally to blend into the fuselage skin.

The lateral posts are comprised of both interior and end posts, depending upon their position in the window frame. The interior posts have a smaller width than the longitudinal trusses, for reasons explained hereinbelow. Additionally, the interior posts have a single rabbet disposed along the length of opposing post edge portions.

The end posts are disposed at the ends of a section of windows, for example at the last window near the tail of the aircraft, or between the window nearest the nose of the aircraft and the aircraft door, and further have both interior and exterior rabbets along the length of a first edge portion for engagement of the interior and exterior aircraft windows.

The end posts are constructed similarly to the longitudinal trusses, having one edge portion integral with and tapering into the fuselage skin, and an opposite edge portion having both interior and exterior rabbets. The rabbets engage both the interior and exterior windowpanes respectively. The exterior posts have a width and cross-sectional area identical to the width of the longitudinally extending trusses.

The laterally extending interior posts are constructed with a slightly thinner cross-section than the longitudinally extending trusses to allow a single continuous interior window pane to be positioned between and engaged by a pair of end posts and longitudinal trusses. This allows the interior window surface of the passenger seating area along one side of the aircraft, for example, to be comprised of a single convex piece of clear polycarbonate material (as viewed from the exterior of the aircraft) running from one end post to another, without interruption from the interior posts.

The exterior windowpanes are comprised of individual panes of polycarbonate material that engage the exterior rabbets of and are bounded by a spaced pair of lateral posts and both longitudinal trusses. The exterior windowpanes are provided with a notched edge portion around the perimeter thereof for engaging the aforementioned exterior rabbets of the trusses and the end posts. The edge portion around the perimeter of each exterior pane provides a measure of protection against window blowout caused by cabin pressurization. It should be noted that the exterior windowpanes bear the force created by the difference in pressure between the aircraft cabin and the atmosphere when the aircraft is at altitude.

The instant invention also provides for a windowpane occupying a large portion of an aircraft door. The top and bottom sections of the door frame are comprised of the aforementioned longitudinal trusses and the sides thereof are each provided with an end post. In this fashion, a large percentage of the aircraft fuselage from the cockpit to the tail is comprised of window material.

Therefore, it is therefore one object of the instant invention to provide an aircraft window construction that allows for improved passenger visibility.

A yet further object of the instant invention is to provide for an aircraft window construction utilizing composite or alloy material trusses and posts to minimize the amount of structural material required to support the window panes while maintaining the structural integrity of the aircraft.

It is a further object of the instant invention to provide a double-paned aircraft window having an interior pane substantially uninterrupted by vertical structural members.

A yet further object of the invention is to provide an aircraft window construction wherein the intersections of the window frame and the fuselage utilize tapered composite or alloy material reinforcing sections to distribute the forces acting thereon.

Additional objects, features, and advantages of the present invention will become apparent from the subsequent detailed description, taken in conjunction with the accompanying drawing figures.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a forward swept-wing aircraft in accordance with the present invention.

Figure 2 is a view of the aircraft window taken in the direction of the arrow 2 of Fig. 1.

Figure 3 is a view of the instant invention taken along the line 3-3 of Fig. 2.

Figure 4 is a view of the aircraft window taken in the direction of the arrow 4 of Fig. 3.

Figure 5 is a view similar to Fig. 4 with only the exterior windows installed.

Figure 6 is a view of the instant invention taken along the line 6-6 of Fig. 4.

Figure 7 is a view of the instant invention taken along the line 7-7 of Fig. 4.

Figure 8 is a view of an alternative embodiment of the instant invention similar to Fig. 3.

Figure 9 is a perspective view of a swept-wing aircraft in accordance with an alternative embodiment of the instant invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Referring to drawing Fig. 1 and in accordance with the instant invention, a window 10 for an aircraft 20 having a fuselage 22 and a fuselage skin 24, comprises a pair of spaced longitudinal extending trusses 30 integral to the fuselage skin 24 interconnected by a plurality of laterally extending interior posts 50 and at least two laterally extending end posts 60 disposed therebetween. The trusses 30 have a relatively greater cross-section than that of the fuselage skin 24.

As best seen in Fig. 2 the trusses 30 are disposed along the fuselage 22 in generally parallel spaced relation to each other to define the top and bottom of the window 10 opening. Both trusses 30 are comprised of the same known-in-the-art composite or alloy

material as employed in the fuselage skin 24 and are constructed as an integral part thereof. Each truss has a first elongated edge portion 32 extending both laterally and longitudinally along the fuselage 22.

As shown in Figs. 2 & 3, each truss 30 first edge portion 32 is comprised of a plurality of exterior rabbets 34 disposed along the entire length of the first edge portion 32, and an interior rabbet 36 disposed along the entire length of the edge portion 32 of the truss 30. The exterior rabbets 34 and the interior rabbets 36 are substantially parallel to each other along the length of the truss 30 first edge portion 32.

Furthermore, each longitudinally extending truss 30 has a second edge portion 38 opposite the first edge portion 32 extending both laterally and longitudinally along the length of the truss 30. The second edge portion 38 is integral with a plurality of tapered reinforcement sections 40 blending the substantially thicker truss 30 cross-section into the relatively thin fuselage skin 24. The reinforcement sections 40 are disposed on the trusses 30 at the intersections of the trusses 30 and the laterally extending posts 50 and 60, and have a thickness identical to that of the trusses 30 at the second edge portion 38 thereof tapering to a nominal thickness where the reinforcement sections 40 blend into the fuselage skin 24. It should be noted that in an alternative embodiment of the instant invention the trusses 30 and the posts 50 and 60 each have hollow interiors for minimizing the weight thereof.

The exterior rabbets 34 provide a mating surface for a plurality of convex shaped exterior windowpanes (as viewed from the exterior of the aircraft) 70 having a notched edge portion 72 disposed around the perimeter thereof. The exterior rabbet 34 of the truss 30 engages the notched edge portion 72 of the exterior window panes 70 to prevent the panes 70 from "blowing out" due to the pressure differential between the interior of the aircraft 20 and the atmosphere at altitude. The plurality of exterior windows 70 form a substantially smooth surface with the fuselage skin 24 on the exterior of the aircraft 20 when the windows 70 are properly engaged by the rabbets 34.

As best seen in Figs. 3 & 4, a single convex interior window 80 has a shaped edge portion 82 disposed around the perimeter thereof to engage the interior rabbet 36 of the longitudinally extending trusses 30. The interior window 80 is disposed substantially parallel to the plurality of exterior window panes 70, wherein the interior rabbet 36 of the truss 30 engages the edge portion 82, thereby forming a double paned aircraft window 10.

Both the interior 80 and exterior 70 windows are secured in place by applying a suitable airtight adhesive to the edge portions thereof, thereby creating a dead air space therebetween. This air space acts as an efficient insulator, thus protecting passengers from temperature extremes. Both the exterior windows 70 and the interior window 80 can further comprise a plurality of arcuate sections 84 at the corners thereof, providing the windows 70 and 80 with rounded corners.

Referring to Figs. 5 & 6, and in accordance with the preferred embodiment of the instant invention, the opposing longitudinally extending trusses 30 are interconnected by a plurality of elongated spaced laterally extending interior posts 50, each having opposing edge portions 52 extending both laterally and longitudinally along the length of the interior posts 50. Each edge portion 52 is provided with an exterior rabbet 54 disposed along the entire length thereof. The interior post rabbets 54 intersect and are integral with the truss 30 exterior rabbets 34 to form a plurality of continuous exterior rabbet surfaces 90 for engaging the notched edge 82 of the exterior window panes 70.

As shown in Figs. 5 & 7, at least two elongated laterally extending end posts 60 are provided having opposing first and second edge portions 62 and 64 respectively, extending both laterally and longitudinally along the length of the post 60. The end posts 60 are disposed between the opposing ends of the trusses 30. Each end post 60 is provided with an exterior rabbet 66 and an interior rabbet 68 disposed along the first edge portion 62 thereof. The end posts 60 intersect and are integral to both the top and bottom trusses 30 to provide an end to the window structure 10. As with the interior posts 50, the end post 60 exterior rabbet 66 intersects both the top and bottom truss 30 exterior rabbets 34 to form a continuous exterior rabbet surface 90 for engaging the plurality of exterior window panes 70. The second edge portion 64 is integral with and tapers into the relatively thin fuselage skin 24.

Similarly, the interior rabbet 68 of the end posts 60 intersects the interior rabbets 36 of the top and bottom trusses 30 to form a continuous interior rabbet surface 100 extending around the perimeter of the interior window 80 and engaging the edge portion 82 thereof. The interior rabbet surface 100 is comprised of the individual interior rabbets 36 of the trusses 30, and the interior rabbets 68 of the end posts 60.

As best viewed in Fig. 6, the interior posts 50 must have a cross-section slightly smaller than that of the trusses 30 to allow the engagement of the interior window pane 80

edge portion 82 with the continuous interior rabbet surface 100. This feature of the instant invention allows the interior window 80 of the instant invention to be comprised of a continuous piece of suitable window material, such as Plexiglas or a similar polycarbonate, uninterrupted by structural posts in the interior of the aircraft 20.

As shown in Figs. 4 & 6, the continuous interior window 80 may further have a plurality of weep holes 86 disposed along the bottom edge thereof, to allow for the escape of condensation from between the interior 80 and exterior 70 window panes.

In accordance with an alternative embodiment of the instant invention and as shown in Fig. 8, the trusses 30, the interior posts 50, and the end posts 60 each have an exterior rabbet 34, 54, and 68 respectively, oriented to engage a shaped edge 74 of a single exterior window 70 when positioned from the exterior of the aircraft. In this embodiment of the instant invention, the exterior windowpane 70 is positioned to engage the rabbets 34, 54, and 68 from the exterior of the aircraft and is secured thereto using a known-in-the-art epoxy adhesive suitable for bonding polycarbonate and composite fiber materials. This embodiment of the instant invention allows a single exterior windowpane 70 occupying the entire length of the fuselage window section to be employed, similar to the continuous interior window 80. The interior laterally extending posts 50 are disposed between and act to separate the exterior 70 and interior 80 windowpanes.

It should be noted that the instant invention can further be utilized in conjunction with conventional aircraft door by providing a door with an opposed pair of longitudinally extending trusses 30 and a pair of spaced laterally extending end posts 60 integral thereto. If necessary, the cross-section of the end posts 60 may be increased to accommodate the required locking and latching mechanisms therein.

In accordance with an additional embodiment of the instant invention as shown in Fig. 9, the aircraft window 10 is elliptical or oval such that the interior windowpane 80 and the plurality of exterior windowpanes 90 form a substantially elliptical shape when engaged in their respective rabbets.

While the preferred embodiment of the instant invention has been disclosed in detail, it will be appreciated by one of ordinary skill in the art that the instant invention is susceptible to various modifications without departing from the scope of the following claims.

I claim:

1. A window for an aircraft fuselage having a longitudinal axis and a fuselage skin comprising:

a pair of longitudinally extending trusses integral with said fuselage skin, said trusses having a first edge portion extending laterally along the length of the truss comprised of a plurality of exterior rabbets disposed along the entire length thereof and an interior rabbet disposed along the entire length thereof, and a second edge portion opposite the first edge portion extending laterally along the length of said trusses integral with and tapering into said fuselage skin, said trusses lying in generally parallel spaced relation to each other and having a substantially greater cross-section than said fuselage skin;

a plurality of tapered reinforcement sections integral with said fuselage skin and intersecting the second edge portion of said trusses;

a plurality of spaced laterally extending interior posts having a smaller cross-section than said trusses and having a pair of opposed edge portions extending both laterally and longitudinally thereon, the edge portions each having a rabbet disposed along the entire length thereof that intersects and is integral with the truss exterior rabbets, thereby forming a plurality of continuous rabbeted surfaces;

at least two laterally extending end posts disposed between said trusses having opposing first and second edge portions extending both laterally and longitudinally along the length thereof, the first edge portion having an interior rabbet disposed along the entire length thereof that intersects and is integral with the interior rabbets of said trusses and an exterior rabbet disposed along the entire length thereof that intersects and is integral with the exterior rabbets of said trusses, the second edge portion being integral with and tapering into said fuselage skin;

a plurality of convex exterior windowpanes having a notched edge portion disposed around the perimeters thereof for engaging the exterior rabbets of said trusses, said interior posts, and said end posts, and;

a single convex interior windowpane disposed substantially parallel to said plurality of exterior windowpanes, having an edge portion disposed around the

perimeter thereof for engaging the interior rabbets of said trusses and said end posts.

2. A bridge truss window for an aircraft fuselage having a longitudinal axis and a fuselage skin comprising:

a pair of longitudinally extending trusses integral with said fuselage skin, said trusses having a first edge portion extending laterally along the length of the truss comprised of a plurality of exterior rabbets disposed along the entire length thereof and an interior rabbet disposed along the entire length thereof, and a second edge portion opposite the first edge portion extending laterally along the length of said trusses and integral with and tapering into said fuselage skin, said trusses lying in generally parallel spaced relation to each other and having a substantially greater cross-sectional area than said fuselage skin;

a plurality of tapered reinforcement sections integral with said fuselage skin and intersecting the second edge portion of said trusses;

a plurality of spaced laterally extending interior posts having a smaller cross-section than said trusses and having a pair of opposed edge portions extending both laterally and longitudinally thereon, the edge portions each having a rabbet disposed along the entire length thereof that intersects and is integral with the truss exterior rabbets, thereby forming a plurality of continuous rabbeted surfaces;

at least two laterally extending end posts disposed between said trusses having opposing first and second edge portions extending both laterally and longitudinally along the length thereof, the first edge portion having an interior rabbet disposed along the entire length thereof that intersects and is integral with the interior rabbets of said trusses and an exterior rabbet disposed along the entire length thereof that intersects and is integral with the exterior rabbets of said trusses, the second edge portion being integral with and tapering into said fuselage skin;

a single convex exterior windowpane having a shaped edge portion disposed around the perimeter thereof;

a single convex interior windowpane disposed substantially parallel to said plurality of exterior window panes having an edge portion disposed around the

perimeter thereof for engaging the interior rabbets of said trusses and said end posts; and

wherein the exterior rabbets of said trusses, said interior posts, and said end posts are oriented to engage the shaped edge of said exterior windowpane from the exterior of said aircraft.

3. A window as claimed in claim 1 wherein said interior windowpane has a plurality of weep holes therein to allow for the release of condensation from between said interior windowpane and said exterior windowpanes.

4. A window as claimed in claim 2 wherein said interior windowpane has a plurality of weep holes therein to allow for the release of condensation from between said interior windowpane and said exterior windowpane.

5. A window as claimed in claim 1 wherein said trusses, said interior posts, said end posts, and said tapered reinforcement sections are comprised of a composite material.

6. A window as claimed in claim 2 wherein said trusses, said interior posts, said end posts, and said tapered reinforcement sections are comprised of a composite material.

7. A window as claimed in claim 5 wherein said trusses, said interior posts, said end posts, and said tapered reinforcement sections have a hollow cross-section.

8. A window as claimed in claim 6 wherein said trusses, said interior posts, said end posts, and said tapered reinforcement sections have a hollow cross-section.

9. A window as claimed in claim 1 wherein said exterior windowpanes and said interior windowpane have a substantially elliptical shape.

10. A window as claimed in claim 2 wherein said exterior windowpane and said interior windowpane have a substantially elliptical shape.

11. A window as claimed in claim 3 wherein said exterior windowpanes and said interior windowpane have a substantially elliptical shape.

12. A window as claimed in claim 4 wherein said exterior windowpane and said interior windowpane have a substantially elliptical shape.

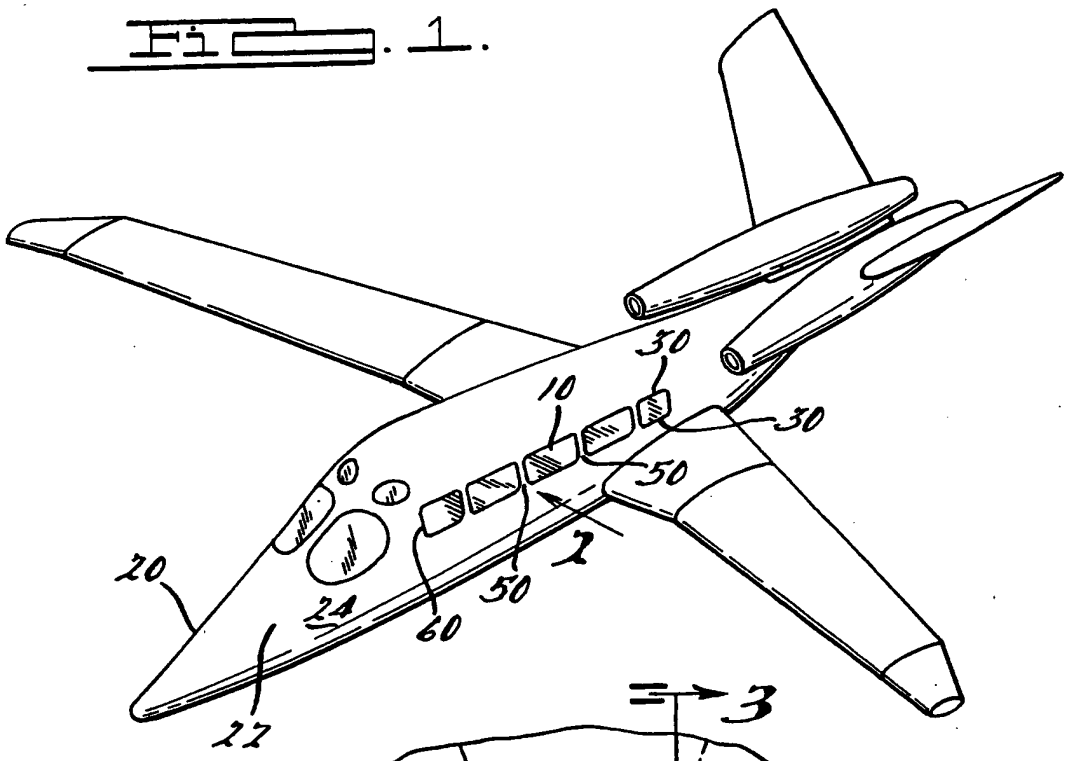
13. A window as claimed in claim 5 wherein said exterior windowpanes and said interior windowpane have a substantially elliptical shape.

14. A window as claimed in claim 6 wherein said exterior windowpane and said interior windowpane have a substantially elliptical shape.

15. A window as claimed in claim 7 wherein said exterior windowpanes and said interior windowpane have a substantially elliptical shape.

16. A window as claimed in claim 8 wherein said exterior windowpane and said interior windowpane have a substantially elliptical shape.

Fig. 1.



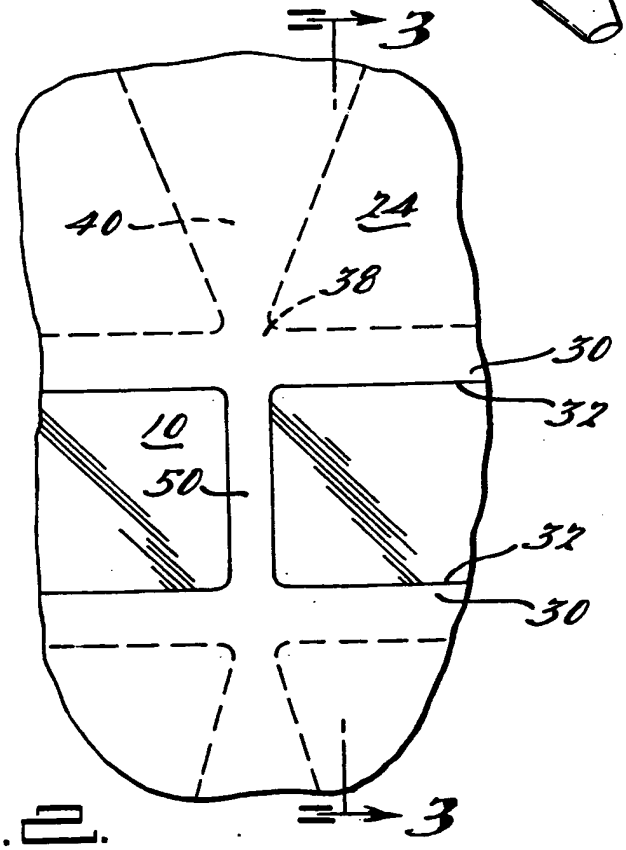


Fig. 2.

Fig. 3.

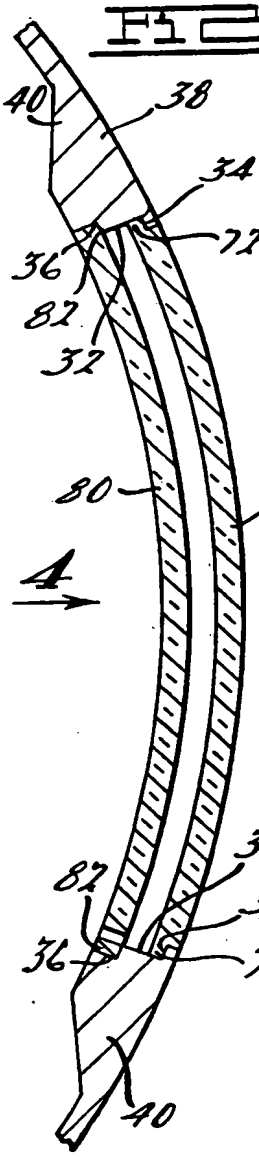


Fig. 5.

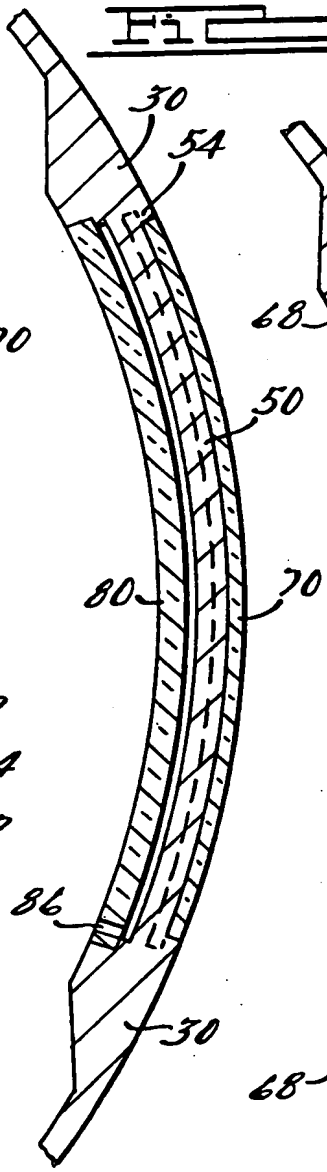
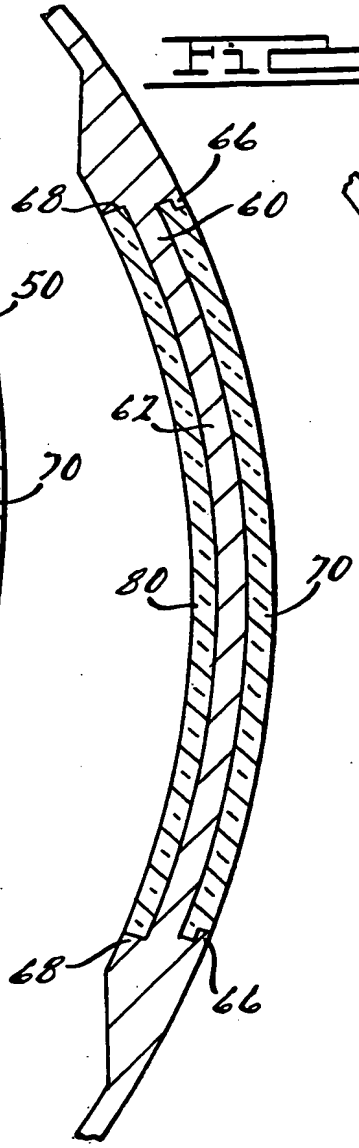


Fig. 4.



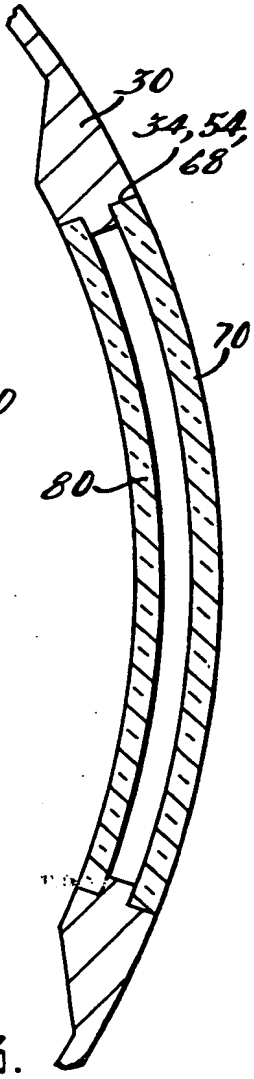


Fig. 6.

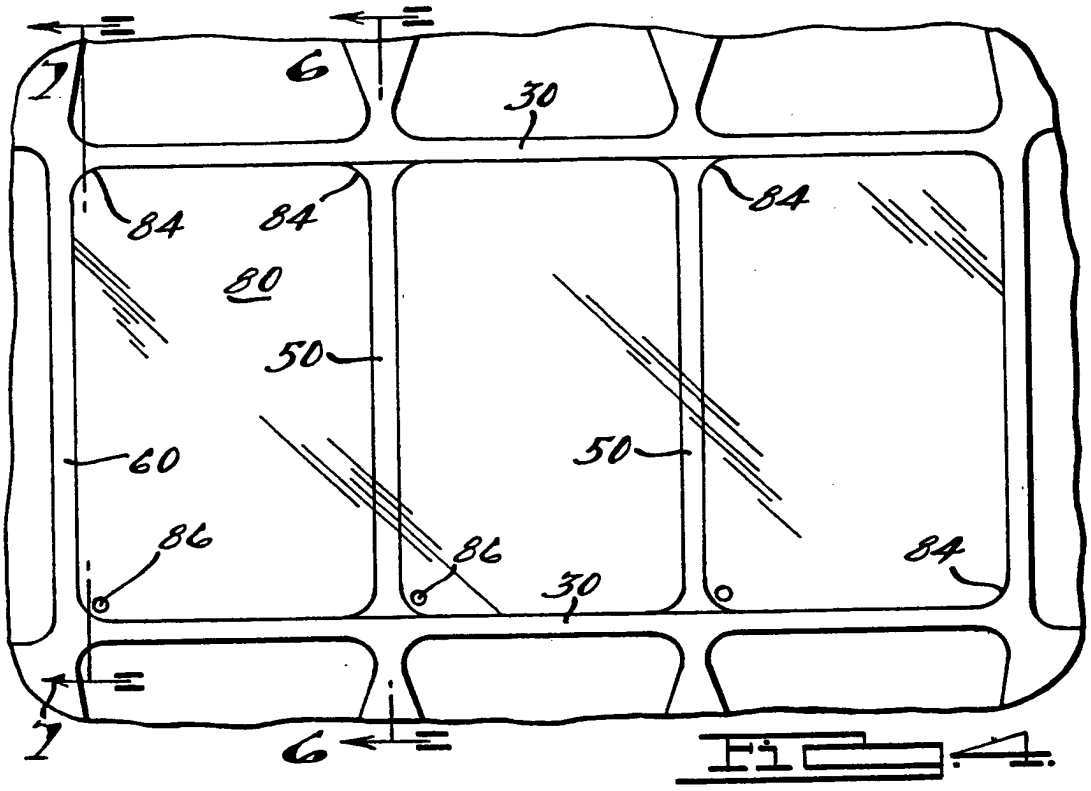

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Fig. 4.

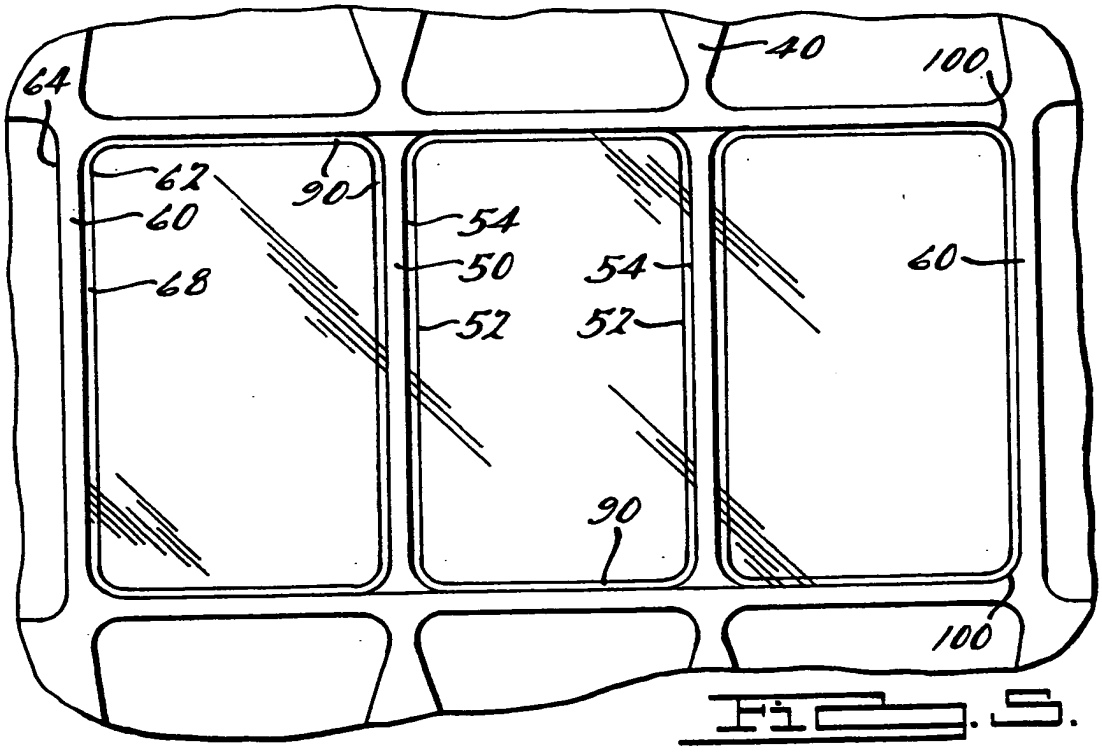
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Fig. 5.

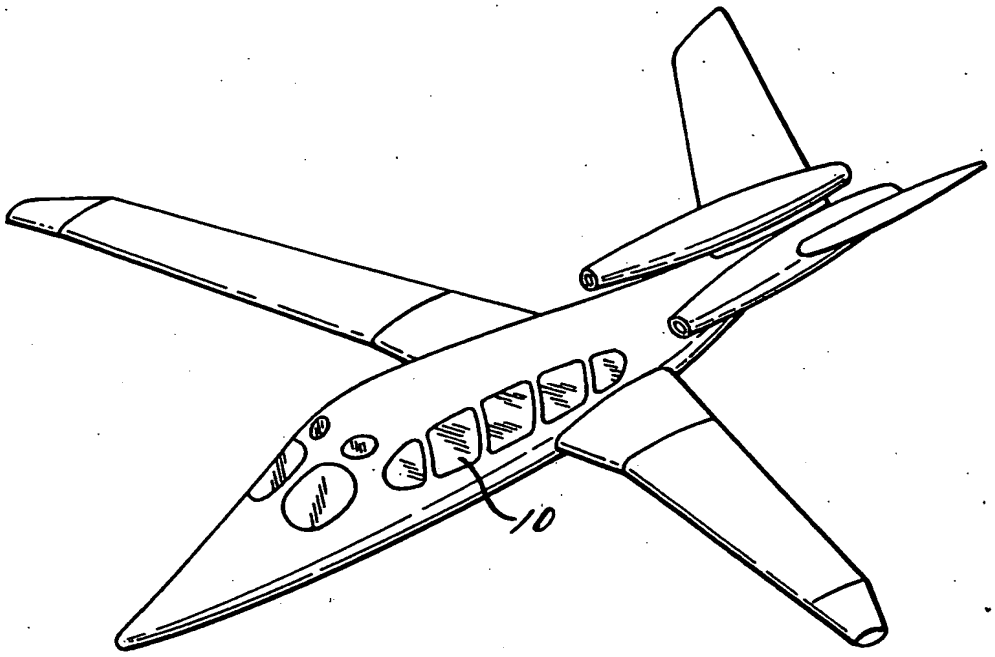

Fig. 9.

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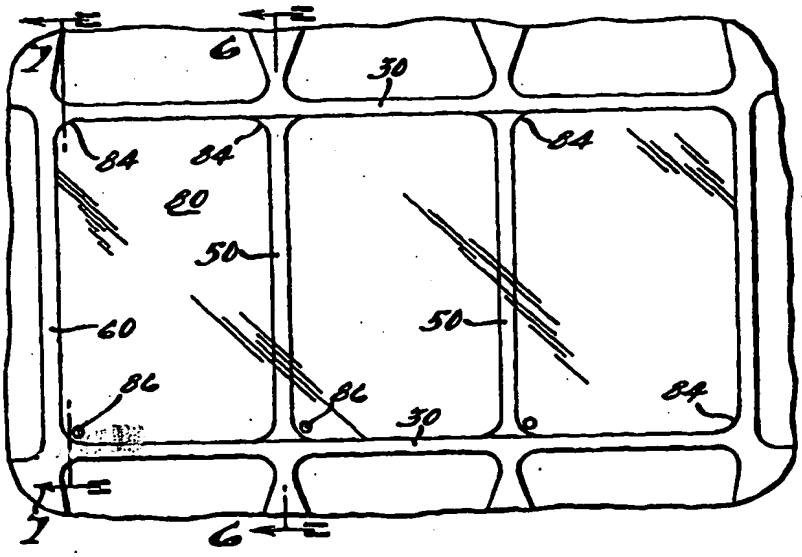

(57) Abstract

The instant invention generally relates to a double–paned window (10) for an aircraft (20) providing greater passenger visibility and overall area than known–in–the art window construction. Specifically, the invention provides for a pair of generally parallel longitudinally extending trusses (30) intersected by a plurality of spaced laterally extending interior (58) and end posts (60) to provide a strong, lightweight structure for an aircraft window. The structural members can be comprised of composite material or known–in–the art aircraft alloy materials that are integral with and taper into the fuselage skin. A plurality of rabbets (34, 36) disposed around the perimeter of both the horizontal trusses (30) and vertical posts (50, 60) engage both a continuous interior window (80) and a plurality of exterior windows (70) to prohibit window blowout.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/21302

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :B64C 1/14
US CL :244/129.3, 117R

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 244/129.3, 117R, 119, 118.5

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,E	US 5,988,566 A (MEYER) 23 November 1999 (23/11/99), see entire document.	1-16
A	US 5,467,943 A (UMEDA) 21 November 1995 (21/11/95), see entire document.	1-16
A	US 5,271,581 A (IRISH) 21 December 1993 (21/12/93), see entire document.	1-16
A	US 5,044,578 A (WHITE ET AL) 3 September 1991 (03/09/91), see entire document.	1-16
A	US 3,429,530 A (HERTEL) 25 February 1969 (25/02/69), see entire document.	1-16

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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